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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/040,948	01/05/2002	Steven Teig	SPLX.P0025	7771

23349 7590 02/07/2003

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EXAMINER

WHITMORE, STACY

ART UNIT PAPER NUMBER

2812

DATE MAILED: 02/07/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	Application No. 10/040,948	Applicant(s) TEIG ET AL.	
	Examiner Stacy A Whitmore	Art Unit 2812	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 05 January 2002.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 27-52 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 27-33 and 39-47 is/are rejected.
- 7) ☒ Claim(s) 34-38 and 48-52 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 05 January 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                  | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____  |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)         | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other: _____                                    |

## DETAILED ACTION

### Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

1. Claims 27-29, 31-33, and 39-42 are rejected under 35 U.S.C. 102(b) as being anticipated by Vannelli, "An adaptation of the interior point method for solving the global routing problem".
2. As for claim 27, Vannelli taught the invention as claimed, including a method of routing nets within a particular region of a design layout, each net having a set of pins [pg 193, section 1, second paragraph, pg. 193, right hand side second full paragraph], the method comprising:
  - a) partitioning the design region into a first set of sub-regions [pg. 193, section 1, second paragraph];
  - b) for each particular net, identifying a set of routes, wherein each route in the route set identified for a particular net traverses a set of sub-regions containing the particular net's pins, wherein each route includes a set of route edges, and each route edge connects two sub-regions [pg. 194, section II, especially the first paragraph, "Note that if there are five ways.....we must choose only one way to connect this net. ....through the second paragraph, and right hand side, section on the Net # 1, and Tree # 1-4; and pg. 195, fig. 1];

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c) formulating a linear-programming ("LP") problem based on the identified routes [pg. 194, section II, especially the first paragraph, "Note that if there are five ways.....we must choose only one way to connect this net. .... through the second paragraph, and right hand side, section on the Net # 1, and Tree # 1-4; and pg. 195, fig. 1; and pg. 194, especially the first formula after the first paragraph of section II]; and  
d) solving the LP problem to identify one route for each net [pg. 194, especially the first formula after the first paragraph of section II].

3. As for claim 28, Vannelli disclosed wherein formulating an LP problem includes using the identified routes to specify an objective function to optimize [pg. 194, section II, especially right hand side, third full paragraph, and last paragraph including the formula: the minimization of wirelength is an objective function].

4. As for claim 29, Vannelli disclosed wherein the objective function includes a component for the overall length of the routes for the nets, and solving the LP problem includes searching for a solution to the objective function that reduces the overall-length component [pg. 194, section II, especially right hand side, third full paragraph, and last paragraph including the formula: the minimization of wirelength is an objective function].

5. As for claim 31, Vannelli disclosed wherein a plurality of paths exist between the sub-regions, wherein a plurality of the paths are diagonal paths, wherein the routes are defined with respect to the paths between the sub-regions [pg. 196, discussion of formulas 3.1 – 3.3, and pg. 197, especially right hand side, last six lines].

As for claim 32, Vannelli disclosed wherein the objective function includes a congestion-component that quantifies the congestion of the paths [pg. 194, third paragraph, and tree #'s; ], and solving the LP problem includes:

measuring the congestion of the paths for each solution considered by the objective function; identifying a solution that reduces the congestion of the paths [pg. 193, arc

capacity; pg. 196, step 7 through equation 3.2: checking is equivalent to identifying, and equation 3.2 reduces the congestion].

6. As for claim 33, Vannelli disclosed wherein formulating an LP problem includes specifying a congestion constraint regarding the congestion of the paths between the sub-regions [pg. 193, arc capacity; pg. 196, step 7 through equation 3.2: checking is equivalent to identifying, and equation 3.2 reduces the congestion; and pg. 195, section 3, first 2 lines].

7. As for claim 39 Vannelli disclosed wherein formulating an LP problem includes specifying at least one congestion constraint [pg. 193, arc capacity; pg. 194, section II, especially the first paragraph, "Note that if there are five ways.....we must choose only one way to connect this net. ....through the second paragraph, and right hand side, section on the Net # 1, and Tree # 1-4; and pg. 195, fig. 1].

8. As for claim 40, Vannelli disclosed wherein specifying at least one constraint includes requiring that only one route be selected for each net [pg. 194, section II, especially the first paragraph, "Note that if there are five ways.....we must choose only one way to connect this net. ....through the second paragraph, and right hand side, section on the Net # 1, and Tree # 1-4; and pg. 195, fig. 1].

9. As for claim 41, Vannelli disclosed wherein the formulated LP problem is an integer linear-programming ("ILP") problem, and the solving of the ILP problem returns integer solutions that specify one route for each net [pg. 194, section II, especially first paragraph; and pg. 196, left hand side, first full paragraph].

10. As for claim 42, Vannelli disclosed wherein the solving of the LP problem includes searching through sets of real-number solutions for each net, wherein each set of real-number solutions for a particular net specifies a real-number value for each route in the set of routes for the particular net, wherein requiring that only one route be

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selected for each particular net includes specifying that the sum of the real-number value in each set of real-number values equals 1 [pg. 194, section II, especially first paragraph; and pg. 196, left hand side, first full paragraph].

### Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claims 43-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Vannelli, "An adaptation of the interior point method for solving the global routing problem".

12. As for claim 43, Vannelli taught the invention substantially as claimed, including computer readable medium comprising a computer program having executable code, the computer program for routing a net within a particular region of a design layout, the net having a plurality of pins [pg 193, section 1, second paragraph, pg. 193, right hand side second full paragraph], the computer program comprising:

- a) a first set of instructions for partitioning the design region into first set of sub regions [pg. 193, section 1, second paragraph];
- b) a second set of instructions for identifying, for each particular net, a set of routes, wherein each route in the route set identified for a particular net traverses a set of sub-regions containing the particular net's pins, wherein each route includes a set of route

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edges, and each route edge connects two sub-regions [pg. 194, section II, especially the first paragraph, "Note that if there are five ways.....we must choose only one way to connect this net. ....through the second paragraph, and right hand side, section on the Net # 1, and Tree # 1-4; and pg. 195, fig. 1];

c) a third set of instructions formulating a linear-programming ("LP") problem based on the identified routes [pg. 194, section II, especially the first paragraph, "Note that if there are five ways.....we must choose only one way to connect this net. ....through the second paragraph, and right hand side, section on the Net # 1, and Tree # 1-4; and pg. 195, fig. 1; and pg. 194, especially the first formula after the first paragraph of section II]; and

d) a fourth set of instructions solving the LP problem to identify one route for each net [pg. 194, especially the first formula after the first paragraph of section II].

Vannelli did not specifically disclose first through fourth sets of instructions for performing the steps of claim 43.

Vannelli disclosed the use of computer program code for the routing and solving the linear program [pg. 197, last line – pg. 198].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize the claimed first through fourth sets of instructions for the purpose of performing the steps for routing a design layout because the computer program utilized by Vannelli uses instruction sets for performing the program methods disclosed and using sets of instructions would be necessary for the proper operation of the computer programs used by Vannelli.

13. Claims 44-47 have correspondingly similar limitations as claims 28-33, respectively. and further require sets of instructions for performing the steps as cited in the corresponding claims 28-33.

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Vannelli did not specifically disclose sets of instructions for performing the steps.

Vannelli disclosed the use of computer program code for the routing and solving the linear program [pg. 197, last line – pg. 198].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize the claimed sets of instructions for the purpose of performing the steps for routing a design layout because the computer program utilized by Vannelli uses instruction sets for performing the program methods disclosed and using sets of instructions would be necessary for the proper operation of the computer programs used by Vannelli.

14. Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Vannelli, "An adaptation of the interior point method for solving the global routing problem" in view of Theune, "HERO: hierarchical EMC-constrained routing".

15. As for claim 30 Vannelli disclosed the invention substantially as claimed, including the method of routing nets including the objective function and solving the LP problem as cited in the rejections of claims 27-28.

Vannelli did not disclose wherein the objective function includes a component for the expected number of vias for the routes for the nets, and solving the LP problem includes searching for a solution to the objective function that minimizes the via number component.

Theune disclosed minimizing the via number component [pg. 470, right hand side, line 4].



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It would have been obvious to combine the teachings of Vannelli and Theune because utilizing Vannelli's objective function and LP problem solver to minimize vias as suggested by Theune would have improved Vannelli's method by minimizing the number of conflicts to be resolved between layers which would improve Vannelli's layout structure when complete by avoiding too many vias [see Theune, pg. 470, right hand side, first paragraph].

16. Claims 34-38, and 48-49 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

17. The following is a statement of reasons for the indication of allowable subject matter: As for claims 34 and 44, the prior art of record fails to teach either singularly or in combination wherein some of the paths share common regions with other paths, wherein formulating an LP problem includes specifying that the capacity of common regions be properly shared among the paths. As for claims 35-38 and 49-52, the prior art of record fails to teach either singularly or in combination wherein a plurality of inter-sub-region edges exist between the sub-regions, wherein a plurality of the inter-sub-region edges are diagonal, wherein the routes are defined with respect to the inter-sub-region edges.

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Stacy A Whitmore whose telephone number is (703) 305-0565. The examiner can normally be reached on Monday-Thursday, alternate Friday 6:30am - 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Niebling can be reached on (703) 308-3325. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7724 for regular communications and (703) 308-7724 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Stacy A Whitmore

Patent Examiner

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SW

February 5, 2003

A handwritten signature in black ink, appearing to read 'Stacy A. Whitmore', written in a cursive style.